US009636702B2

(12) **United States Patent**
Love, III et al.

(10) **Patent No.: US 9,636,702 B2**
(45) **Date of Patent: May 2, 2017**

(54) **APPARATUS AND METHOD FOR CONTROLLED APPLICATION OF LIQUID STREAMS TO A SUBSTRATE**

(71) Applicant: **Milliken & Company**, Spartanburg, SC (US)

(72) Inventors: **Franklin S. Love, III**, Columbus, NC (US); **Joseph E. Rumler**, Greenville, SC (US); **Mark A. Hornung**, Campobello, SC (US); **James C. Bryant**, Cowpens, SC (US); **Sharon E. Koh-Fallet**, Simpsonville, SC (US)

(73) Assignee: **Milliken & Company**, Spartanburg, SC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/097,329**

(22) Filed: **Apr. 13, 2016**

(65) **Prior Publication Data**

US 2016/0221030 A1 Aug. 4, 2016

Related U.S. Application Data

(62) Division of application No. 14/533,313, filed on Nov. 5, 2014, now Pat. No. 9,339,834, which is a division of application No. 12/850,166, filed on Aug. 4, 2010, now abandoned.

(51) **Int. Cl.**
B05B 15/04 (2006.01)
B05D 1/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B05D 1/02*** (2013.01); ***B05B 1/205*** (2013.01); ***B05B 1/267*** (2013.01); ***B05B 1/28*** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,942,342 A 3/1976 Klein et al.
3,942,343 A 3/1976 Klein
(Continued)

FOREIGN PATENT DOCUMENTS

EP 0 289 263 11/1988
EP 0 514 102 11/1992
GB 1 456 458 11/1976

OTHER PUBLICATIONS

Patent Cooperation Treaty PCT International Search Report. Date of Mailing: Oct. 27, 2011. International Application No. PCT/US2011/043981. International Filing Date: Jul. 14, 2011.

Primary Examiner — Nathan T Leong
(74) *Attorney, Agent, or Firm* — Brenda D. Wentz

(57) **ABSTRACT**

An improved system for application of liquid streams to a substrate. The system incorporates open face flow channels for carrying the liquid away from fully enclosed flow segments prior to discharge along an unconstrained flow path. The present invention further provides an improved, self-aligning modular assembly for delivery of impingement jet to the liquid streams for diverting the direction of the liquid streams. The present invention further provides an improved arrangement for collection of the deflected liquid in response to application of the impingement jet without excess residue build-up.

6 Claims, 6 Drawing Sheets